SPECIAL REPORT

Integrated Intelligence

Human Uses of, Strategies on, and Rules for Artificial Intelligence in the 21st Century

Illustration / Getty Images

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Human Uses of, Strategies on, and Rules for Artificial Intelligence in the 21st Century

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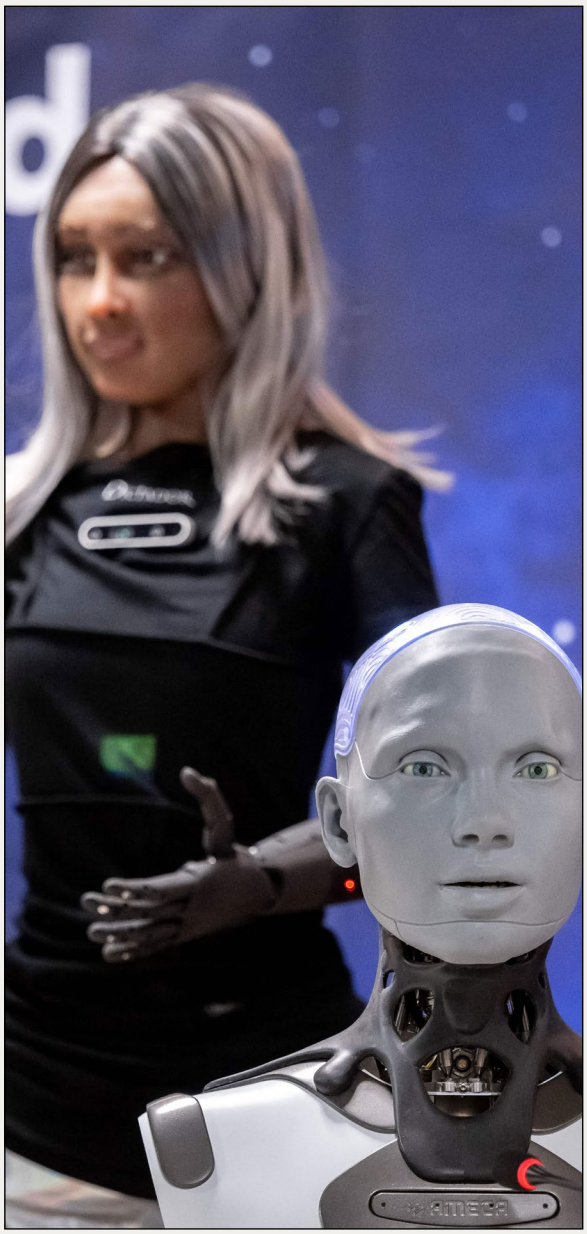
COVER: Artificial intelligence illustration showing robot emerging from computer code. (Yuichiro Chino / Getty Images)
(The New Lines Institute for Strategy and Policy)

Executive Summary

Humans have entered an age of artificial intelligence – or, rather, of integrated intelligence. Already becoming more familiar with some forms of artificial intelligence in their daily lives, they'll inevitably embrace new technologies and techniques in everything from workplace productivity systems to drug design, manufacturing defect detection, and autonomous weapons. Given tiered societies and the complexity of consequences, American and other leaders must avoid trapping themselves in poor policies and practices. Rather than reacting counterproductively, they must strive for the sweet spot between important and urgent, innovative and responsible, private and public. Because they won't soon be able to resolve substantial uncertainty regarding how strongly or how rapidly people will experience the effects of artificial intelligence, American and other policymakers must get curious, be active, and prepare for a range of potential outcomes. They must work on all fronts, from domestic legislation and international coordination to enterprise policies and personal practices, while accepting that they can't control the future.

In this special report, the Future Frontiers team at New Lines Institute considers and proposes human uses of, strategies on, and rules for artificial intelligence in the 21st century. To do so, we summarize how humans have mythologized, theorized, and made machines since antiquity; explain how scientists and engineers have developed contemporary artificial intelligence during the industrial age, especially after World War II; provide an overview of artificial intelligence's complex consequences in the age of adoption; offer ideas on how American and other leaders may create strategies, policies, and laws on the technology; and consider whether and how people in every segment of society may adopt standards and practices in the coming age of integrated intelligence.



AI robot "Ameca" (foreground) and CEO robot "Mika" are showcased in what was presented as the first press conference with a panel of AI-enabled humanoid social robots. The event was part of International Telecommunication Union AI for Good Global Summit in Geneva in July 2023. The U.N. convened the gathering to map out frontiers of artificial intelligence. (Photo by Fabrice Coffrini / AFP via Getty Images)

From Myths to Machines

"Can machines think?"[1] Humans have long wondered about artificial beings, including those with natural intelligence – or, rather, outputs that resemble assumptions about natural intelligence. For millennia, mythmakers, philosophers, and scientists in different civilizations have wondered about, theorized the existence of, and tried to make machines – however simple, however complex – that are intelligent or mimic natural creatures or phenomena on Earth.

In all eras, they've understood, expressed, and even emphasized important differences between born and bred beings; made, molded, or manufactured devices; and miraculous, mystical, or magical entities or forces. In antiquity, people around the world told tales about beings "made, not born."[2] In China, Greece, Egypt, and Mesopotamia, people delighted in, marveled at, or worried about such beings.[3] During the middle era, Arab and Byzantine rulers reveled in their automata, astounded visitors, and gave gifts to awed recipients while struggling for control over the Levant.[4]

Continuing to contemplate existence in the modern period, philosophers turned their attention to the human body, brain, and/or mind. They also contemplated intelligent automata, machines that could generate textual outputs, and machines that could be instruments of reason. In the industrial era, humans made more complex machines and experimented with mechanical devices, processes, and systems.[5] As they developed and deployed machines, they also confirmed, changed, and uncovered much about their senses of self as individuals; as members of familiar groups, communities, and societies; and alongside or against other humans they deemed more distant.[6] Increasingly, they also made automata that appeared to engage in what people deemed to be higher activities of biological brains or human minds.

Converging and compounding their advances, humans began believing that they could make intelligent machines. Creating the precursors of contemporary conventional computers, polymaths in the 1800s conceived of digital computers and wrote instructions for machine actions.[7] In the ensuing decades, they moved from analog computing to today's digital computers.[8] Now using computers to help complete tasks, humans considered whether they could make machines do more: solve math problems, prove concepts, and engage in other activities associated with animal or human intelligence.[9] They also wondered whether machines could eventually understand these functions and exercises or even be aware of their own existence.[10]

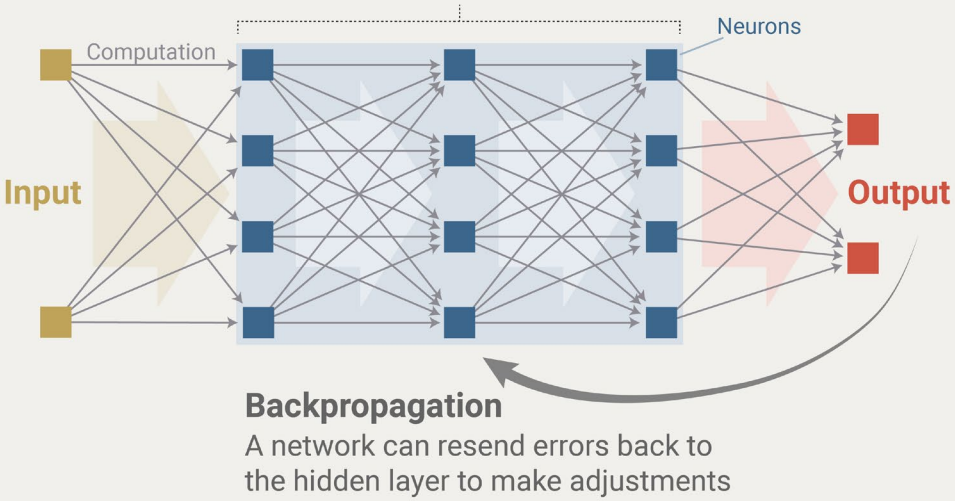
Leaping forward in principle, humans still struggled in practice through the mid-20th century. They couldn't transcend the real roots of synthetic intelligence. After all, physical components, different integrated structures, and architectural arrangements are the foundations of computing power, efficiency, and related resource requirements.[11] In turn, computing power, efficiency, and related resources make synthetic intelligence or pseudo-intelligence possible.[12] Computers simply weren't powerful or sophisticated enough for humans to try to replicate many mental tasks with machines. They also lacked the synthetic equivalent of natural memory, which some asserted was "a key prerequisite for intelligence."[13] Besides, humans needed time to overcome their own obstacles. Even in the United States, which was prosperous absolutely and relatively, few people in the tiered society had a chance to help shape the future in this area of activity.

Even so, people pressed ahead. By the 1950s, scholars had coined the term "artificial intelligence."[14] Collecting and continuing older research, with different degrees of coherence and cross-disciplinary work, they developed new technology and techniques while drawing from the realms of "automata,"[15] "cybernetics,"[16] "thinking machines,"[17] and "digital computing."[18] Sometimes, they made progress as they'd planned. At other times, they failed to uncover the unknown in one area – only to inadvertently open a door into another. By incorrectly trying to explain human synapses though logic, symbols, and simple thresholds, for instance, scientists created a template for subsequent researchers who experimented with neural networks and tried techniques such as deep machine learning.[19]

Focusing on the future, humans began believing that they'd deliver the dreams of the past. They created a community of practice in

A Simple, Synthetic Neural Network

The illustration shows a simplified diagram of the complex function of a neural network. Experts consider backpropagation (a machine learning algorithm) with synthetic neural networks to be "leaky abstractions" and emphasize that it is important to try to grapple with underlying details and dynamics.



Sources: New Lines Institute research including interviews with developers, and a review of books, journals, and technical papers from 2022 and 2023

government, universities, and think tanks.[20] Taking different inputs, machines produced humanlike outputs. Machines did math, broke codes, played chess, recognized notes and tunes, and composed music.[21] Researchers made or claimed to be making rapid, radical progress in everything from gameplay to strategy, mathematics, and music.[22] They believed they could create systems, programs, and machines that would become indistinguishable from – or even surpass – the capacities of humans within a decade.[23]

As promises turned to problems, though, the creators of artificial intelligence fell back into the longer slogs of research. Considering the "overall pattern" of relevant research, scientists and philosophers went from celebrating "early, dramatic success based on the easy performance of simple tasks, or low-quality work on complex tasks" to struggling with "diminishing returns, disenchantment, and, in some cases, pessimism."[24] Even if they initially understood that the former would not necessarily be linear, rapid, uniform, or universal,[25] they'd nonetheless set themselves up for the latter by creating unrealistic expectations;[26] by overstating, misrepresenting, or misunderstanding results;[27] and by engaging in boosterism,[28] which they conflated with analysis.[29]

During a "Winter" beginning in the 1970s, researchers working on artificial intelligence struggled with paradoxes found in different disciplines. They made objective, or at least observable and technical, progress while succumbing to subjective, or at least personal and philosophical, pessimism. They drew attention, for perceived failure or for "overhyping potential and results," while losing interest, at the expense of "different successes" already achieved or on the horizon. After creating artificial intelligence as a discipline in the mid-20th century, beginning in the 1970s, lawmakers, officials, academics, scientists, and administrators cut funding, reviewed research scope, or cast doubt over individuals and teams working on artificial intelligence.[30] Research institutions and corporations deprioritized or

disparaged the discipline,[31] and governments adopted complex or inconsistent policies.[32]

Amid these obstacles, humans sowed the seeds of future successes for research related to artificial intelligence. They kept making more powerful and sophisticated computers, components, precursor products, and related systems.[33] As they developed different subfields of artificial intelligence, or just euphemistically discussed what generalists and specialists alike sometimes branded a pseudo-science,[34] they tried different technologies and techniques,[35] including logical frameworks, contingent commands, expert systems, neural networks, and deep learning; worked on areas such as logistics,[36] image recognition, and natural language processing; and experimented with different processing units and derived or developed architectures, platforms, interfaces, and software.[37] Eventually, scientists and engineers created the building blocks of several contemporary artificial intelligence systems and platforms.[38] Building with backpropagation,[39] for instance, they applied different techniques in deep learning during the 1980s[40] and 1990s.[41] Essentially identifying and tracing errors in layers between inputs and outputs and calibrating components of the system, they figured out one way to make machines recognize images and text.[42]

In about 2000, artificial intelligence again "bust[ed] out of the lab."[43] For starters, a computer had just defeated a human chess champion.[44] Researchers also reasserted themselves, emphasizing how humans had already used artificial intelligence to affect complex global logistics and transportation systems. In the 2010s, researchers began delivering results and developing approaches that lawmakers,[45] policymakers,[46] professionals,[47] and others now associate with contemporary artificial intelligence. They did so with the size and sophistication of models, putting in place precursors for potentially broad-purpose artificial intelligence.[48] In 2012, researchers at X, a branded moonshot lab at Google, created a model that could recognize images and videos.[49] That same year, academics also created a convolutional neural network model that eclipsed previous performance, worked for new applications, and reduced long-running problems related to parameters, processing, and data.[50] By 2017, Google researchers had proposed an architectural arrangement that would allow for more effective, efficient, and flexible development of network-based artificial intelligence: the transformer.[51]

In developing artificial intelligence, researchers increasingly relied on synthetic neural networks and deep learning that was enhanced by more computing power, parallel processing, and backpropagation. In addition to creating, improving, and adjusting algorithms, they used another revolutionized resource: data.[52] Not only were they able to input text available on the internet,[53] but they also took advantage of digital information in other domains.[54] Combining more processing power, algorithmic improvements, access to information, and techniques based on synthetic networks and deep learning approaches, humans thus hopped from success to success in image, speech, and text recognition;[55] strategy and gameplaying;[56] and generation of information such as text.[57]

Creators of artificial intelligence have continued the patterns of the past. They've created, closed, or reorganized entities. Governments, universities, and investors have put money in, pulled money out, and then again flooded markets yet to emerge and entities yet to establish themselves.[58] Lawmakers, officials, businesspersons, and advisers have considered various measures,[59] ranging from specifically targeting artificial intelligence and generally contemplating its consequences to boosting domestic innovation and constraining adversarial actors both at home and abroad.[60] Others, again, have declared that artificial intelligence has been "overhyped."[61] While they have acknowledged leaps like the processing of unstructured data, they have wondered whether developers were again overpromising, underdelivering, and ultimately mismanaging expectations regardless of results.[62]

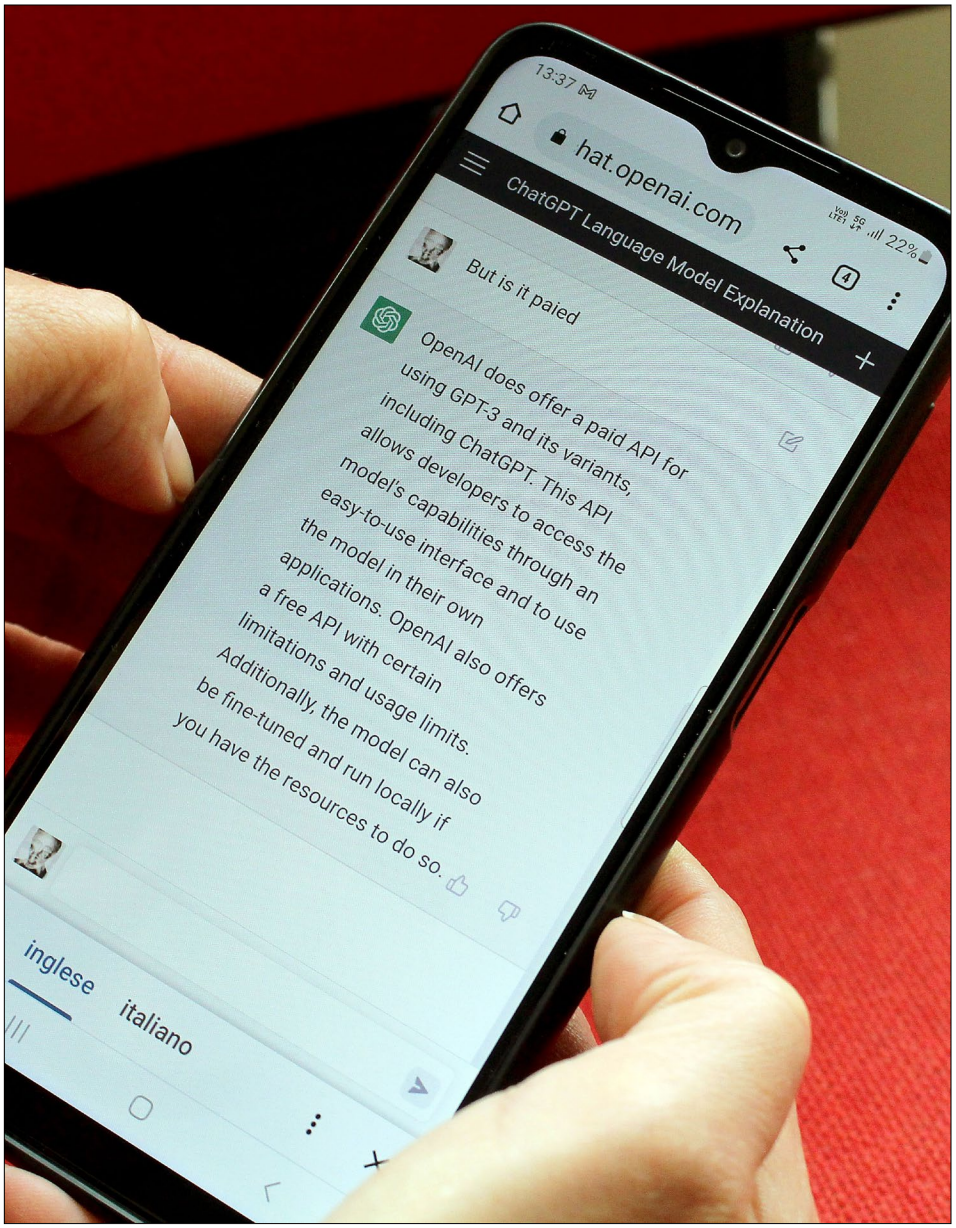
Against this backdrop, artificial intelligence again burst onto the world stage. On Nov. 30, 2022, OpenAI released a new version of one of its artificial intelligence platforms. Humans around the world[63] again fixated on specific types of technologies and techniques already animating their lives; conflated inputs,

processes, and outputs of different systems with their own thoughts, sentiments, and feelings while using or interacting with them;[64] and entered a new era, regardless of their own awareness, literacy, or readiness as individuals, citizens of societies, or members of a species.[65]

Artificial Intelligence in the Societal Mainstream

Humans are entering an "age of adoption" related to artificial intelligence.[66] People in different segments of society have become familiar with artificial intelligence platforms over the past year. Although they aren't yet using or aware of artificial intelligence applications more generally,[67] they've adopted chat-based platforms, large language models, and generative artificial intelligence.[68] So far, they've done this more quickly than they've adopted other systems and platforms in the contemporary computing age.[69]

Less than a year ago, OpenAI released a public version of ChatGPT, a text-based, chat-centric platform through which users can access a large language model, which in turn functions as a kind of generative artificial intelligence system.[70] In so doing, the company leapt ahead of its competitors, both large and small;[71] it amplified the advantages of investors and partners in other spheres; it disrupted others operating in the digital domain;[72] and it simultaneously created a market and captured a significant share of that market.[73] Two months after ChatGPT debuted, it had 100 million users.[74]



ChatGPT is an app that uses artificial intelligence technology such as natural-language processing and machine learning to generate human-like conversation. Its uses include customer service chatbots, virtual assistants and automated customer support. (Donato Fasano / Getty Images)

Reacting to this very quick rate of ChatGPT adoption, global corporations released their own platforms, systems, and models; offered or increased access to "application programming interfaces," which developers essentially use to add artificial intelligence to their own products; began making and touting customized or customizable versions, including entire stacks or systems incorporating hardware,

software, and related resources; and otherwise integrated artificial intelligence into existing enterprises, services, products, and offerings.[75] Already partners, Microsoft and OpenAI doubled down in different ways.[76] Google boosted its Bard platform while emphasizing its other research.[77] Meta released its LLaMA research tool and its Make-A-Video generator. Anthropic, whose leaders include former OpenAI employees, pushed the Claude platform out in early 2023.[78] Building basic architecture, partnering with others[79] across the United States on systems,[80] data, and specialized uses, NVIDIA pushed its own text-based NeMo, visual Picasso, and other platforms.[81] Other firms have done the same throughout 2023,[82] while differing in other choices.[83] Beyond that, researchers continue to design, develop, and deploy such artificial intelligence at a dizzying pace.[84]

Although these platforms and models just a few forms of artificial intelligence, they are proxies[85] for and symbols of complex consequences that the technology will have in societies, regardless of how different stakeholders have cluttered everything from the basic performance of large language models[86] to reasonable rulemaking.[87] Enjoying benefits and suffering harm due to chat-based textual platforms and large language models, Americans and others are already experiencing the promises, perils, and paradoxes of this technology.[88] As they adopt artificial intelligence, ideally creating structures and habits of integrated intelligence, humans must understand and account for how this technology is affecting their society, both today and in the long run.

Artificial Intelligence's Complex Consequences

Artificial intelligence's consequences are and will be complex: revolutionary and mundane, stark and subtle, novel and normal. Humans using artificial intelligence will confirm, challenge, and change their sense of self[89] They'll soon live with and through systems of integrated intelligence.[90] Ideally, humans will use natural abilities and synthetic capabilities to augment both. However, if past is prologue, they'll also simplistically and counterproductively use the latter as a substitute[91] for the former.

The Promise of Artificial Intelligence

Artificial intelligence has astounding promise. It is "difficult to imagine how much the world could change," for the better, especially if humans are able to harness multimodal, generative artificial intelligence and other technology.[92] Setting aside their use of foundational large language models in basic software suites and as agents of the mundane, people will use artificial intelligence systems and programs in their substantive work.[93] They're already doing so, including in old areas of activity such as agriculture, logistics, and administration and across future frontiers such as the human genome, resource transformation, and outer space.[94] Indeed, the U.S. government has been doing so in hundreds of ways.[95] So, too, have some of the largest global corporations in every economic sector and individuals in every segment of society.

Across sectors, humans have been able to improve productivity[96] in immediate, tangible ways through the simple applications of public platforms, premium versions, and broader services or suites.[97] If nothing else, they may improve their ability to manage the mundane.[98] Indeed, people have long been using artificial intelligence to improve operations. For instance, teams have been able to effectively manage world-scale infrastructure projects;[99] complex, sensitive, or fragile energy generation and distribution systems;[100] and asset fleets, including of military and commercial vessels. They've more effectively maneuvered and protected space-based assets.[101] Processing, organizing, and analyzing large amounts of data, they've discovered pattern recognition and clustering approaches.[102] They've also been able to create initial impressions of issues that might have otherwise required humans days, weeks, or even months to complete;[103] to run baseline quantitative analyses, including of information gleaned from drones, medical files, and legal materials; and to identify, organize, and analyze areas for humans to review directly.[104]

Beyond making basic improvements, humans may generally transform "almost every industry"[105] in the coming decades; realize a revolution of aggregated improvements;[106] and/or expand and enrich an existing order whose inheritors may recognize certain

> “With artificial intelligence, humans may revolutionize health care, or aspects of medical care and pharmaceutical segments in tiered systems. Working with U.S.-based global information technology companies, they’ve already promised “precision” medicine and “personalized” health care.”

types of technology as significant “without believing [them] to be special.”[107] Adopting artificial intelligence at different rates and to different extents – especially while considering underlying value, complexity, risk, and reward in activities – they will eventually incorporate it across the board.[108] If enterprises find it easier to rapidly integrate certain types of artificial intelligence into online advertising, productivity software, and service-oriented jobs, both private companies and state-owned enterprises will in the foreseeable future begin using such systems in areas like manufacturing – seemingly at other extremes of human activity. Indeed, they may do so to improve design, rework technical processes, reorganize factories, revamp connected systems, and even detect defects – including those invisible to human eyes and existing sensors and for each widget made, no less.[109]

With artificial intelligence, humans may revolutionize health care, or aspects of medical care and pharmaceutical segments in tiered systems.[110] Working with U.S.-based global information technology companies, they’ve already promised “precision”[111] medicine and “personalized”[112] health care.[113] Even through incremental change, they may drastically “improve health outcomes and the quality of life for millions of people in the coming years.”[114] Using artificial intelligence to help analyze medical images, health care providers will also eventually use such systems to diagnose and treat individual patients while also assessing patterns in data from persons, groups, and different aggregations.[115] In the pharmaceutical industry, conglomerates and bio-innovation firms have already used foundational models and hybrid data sets to revolutionize drug design and development.[116] Slashing the time needed to discover or design drugs, they may also increase benefits and reliability rates in the future.[117] They’ve already used artificial intelligence applications or automated systems to develop drugs in the United States.[118] To shorten other parts of their product pipelines, companies are working with public institutions and private enterprises to improve trial candidate selection, process design, quality control, and more. If they succeed, they’ll “alter the whole notion of production, all the way through individual well-being.”[119]

Using artificial intelligence in every segment, people will transform upstream, midstream, and downstream activities. Doing so in all systems related to generation, distribution, and consumption,[120] they’ll at least make exploration more effective, more efficient, less risky, and – controlling for other factors, none of which have to do with information or analysis – less hazardous for people locally and detrimental to the environment regionally. Although they may transform the entire energy sector through radical solutions, including by combining artificial intelligence and quantum computing to help overcome technical challenges in areas like fusion,[121] policymakers and service providers will likely achieve a revolution of aggregated, incremental improvements in existing approaches and systems.[122]

Americans have long been some of the world’s most sophisticated[123] and productive producers, but in agriculture, they have been adopting artificial intelligence[124] more slowly than in other sectors.[125] After initial investments, trials, and adjustments, which they need to balance against existing methods and implement over different crop cycles, farmers will

use general-purpose and special-purpose systems to increase their output while decreasing costs.[126] As specialized firms sprout, farmers, sector participants, and people around the world may benefit from artificial intelligence applied throughout food-related systems such as logistics, including inadequate cold chains,[127] and the allocation and application of resources, including energy expended to cook or procure food.

With predictive analysis and preventive action, others are using artificial intelligence to revamp global supply systems, logistical processes, and transportation networks.[128] Although autonomous and highly automated vehicles will ultimately be part of broader systems, policymakers and businesspersons may innovate and improve cross-continental transportation and logistics by using current technology across the board.[129] In cities, authorities and enterprises may work together to redesign or optimize traffic flow by analyzing data, with satellites, sensors, cameras, and people providing data inputs. Municipalities and other administrations around the world may also prevent or proactively manage damage rather than engaging in reactive – and, depending on the instance, much more costly and disruptive – infrastructure repairs. State and municipal authorities have already used laser scanning and artificial intelligence to detect, analyze, report on, and prioritize preventive actions – including by, say, identifying road cracks as small as 1 millimeter wide – in nation-states such as the United Arab Emirates.[130]

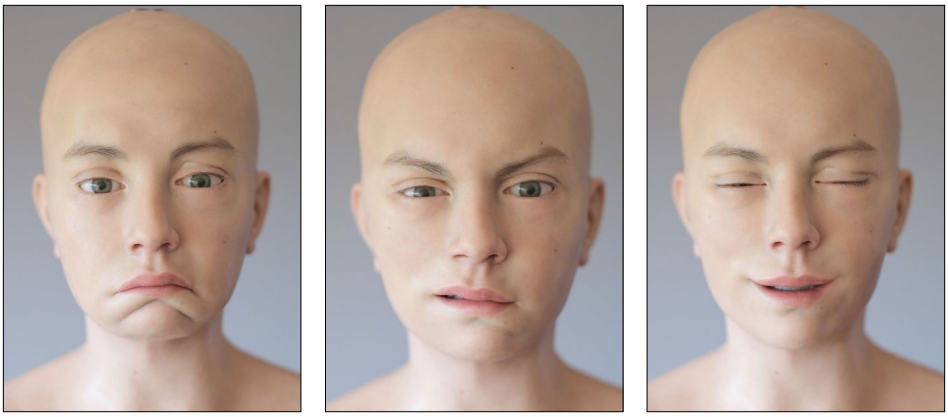
Humans have also applied artificial intelligence while crafting public policy. Pursuant to an executive order and presidential policy statements,[131] U.S. government units have begun to disclose scores of artificial intelligence applications in their work.[132] They may also use artificial intelligence in programs for national security, general operations, substantive analysis, counterespionage, fraud detection, and other sensitive applications both at home and abroad. Without simply replicating "all the complexities of crafting strategic analysis," they may also use artificial intelligence to "automate, enhance, and enable key parts of the analytic process" and "unlock new insights to inform analytic judgments."[133] Authorities have also countered criminal activity at local levels and in transnational contexts while improving awareness of complex urban systems, borderlands,[134] the biosphere, changing seas, and outer space.[135] After identifying and tracking contemporary enslavers and human traffickers,[136] academics and activists may soon be able to detect forced labor in agriculture, livestock production, the extractive industries, and other sectors.[137]

Venturing into once-theorized, now-nascent areas like planetary policy,[138] humans will in the next few decades begin to understand the Earth as never before. With an improved ability to monitor different parts of Earth – including by combining more pervasive and sophisticated satellite coverage, better information collection and classification, and forecasting – humans will be able to produce more food, allocate resources more effectively, and potentially reduce costs of production.[139] They'll understand the biosphere at the highest levels, too: Combining conventional human research and new artificial intelligence applications, for instance, scientists may have already determined the total biomass of wild land mammals (22 million tons) and marine mammals (40 million tons) on Earth.[140] In time, they'll also be able to use artificial intelligence to avoid, adapt to, and perhaps reverse adverse environmental change.[141] And they'll apply the technology beyond Earth, too: With artificial intelligence, comprehensive space situational awareness, and autonomous or at least maneuverable assets, they may be able to create space systems that "live with" threats and hazards such as artificial space debris.[142]

The Challenges of Artificial Intelligence

Artificial intelligence isn't free of perils, paradoxes, and plateaus. Just as humans have created prosperity, liberty, security, and dignity with artificial intelligence, they've also created problems, challenges, risks, and threats.

Having long struggled to define and find justice, humans are applying artificial intelligence in judicial,[143] carceral,[144] and related societal systems.[145] Governments, police, and judiciaries have done so while working with and relying on the private sector. Algorithmic injustice already exists.[146] So, too, do other imbalances related to artificial intelligence: issue selection, design, team structure, data collection and classification,



Abel, the humanoid robot, shows various facial expressions. The robot was created by bioengineers from the University of Pisa along with Gustav Hoegen, an animatronic designer and FX artist. Abel can use generative artificial intelligence and manage it within social contexts, taking into account the emotions of humans interacting with it. (Photo by Vittorio Zunino Celotto / Getty Images)

training practices, use cases, and more. In addition to reinforcing overt biases[147] – such as those related to race,[148] gender,[149] and class[150] – artificial intelligence will likely amplify imbalances: practical advantages;[151] linguistic dominance, socioeconomic background, and sociocultural mores;[152] between owners of technology and those whose livelihoods are exposed to it;[153] and location,[154] scale,[155] and sophistication.[156] Already institutionalizing the use of "predictive algorithms" to allocate resources and manage risk on the ground, leaders in different polities use facial recognition systems with opaque design, likely flawed data sets, generally unobserved inputs, and overt and amplified biases;[157] apply artificial intelligence to predict risks of crime or recidivism; detect or predict fraud;[158] and more.

Managers and administrators use artificial intelligence to screen, sort, rate, monitor, evaluate, and predict the performance or behavior of employees, students, and applicants.[159] Beyond trying to educate students who'll have artificial intelligence at their fingertips, administrators, teachers, and parents will use the technology to determine where children go to school; allocate resources, including money given to institutions and time and attention given to individuals; monitor behavior; and predict outcomes based on different factors. Having for decades used factors like place of birth and names,[160] they can now also use zip codes, different affiliations, typing techniques, fonts, capitalization, and choice of internet browser.[161] They also may weigh hobbies, for instance whether applicants play sports "such as lacrosse or field hockey" or "maybe something like basketball."[162]

Health care providers will also struggle to balance personalization with legal and ethical concerns including privacy. In every ostensibly virtuous circle of accuracy and precision, there are also potentially vicious circles of technical, historical, indirect, and confirmation biases.[163] Health care providers have used artificial intelligence to counter biases, but algorithms, data sets, and human misuse can reinforce biases.[164] Moreover, regardless of whether personalized health care and precision medicine are inherently or unavoidably "unethical"[165] from a societal standpoint, such services will complicate U.S. legislation like the Healthcare Portability and Accountability Act,[166] state laws, association standards, and individual duties of care.[167]

Already plaguing the digital domain, propaganda, disinformation, and misinformation will increase in quantity and sophistication as humans adopt artificial intelligence.[168] Synthetic media will be a problem more generally, too.[169] Misinformation is already a serious challenge with large language models, including problems due to human misuse and predictive generation.[170] While such misinformation is generally a problem in public affairs, it will also become more of a challenge in the private sector and other institutions. When people are interacting with machines that they may see as more accurate and ostensibly more objective than humans, even experienced professionals[171] who work in enterprises familiar with[172] artificial intelligence have failed to account for errors, inaccuracy, imprecision, and false or fictionalized generative outputs.

Propaganda and disinformation will be problems, regardless of

purpose, technique, tone, and creator. For at least a decade, governments and companies have been using generative adversarial networks – or testing functional precursors and equivalents – to pit machine against machine, reinforce system with system, or do both concurrently.[173] As Americans hold elections in 2024, they may do so during the "first campaign cycle rife with [artificial intelligence]-generated propaganda and disinformation."[174] Using recognition systems and generative artificial intelligence, companies have already cut the cost of cloning a voice to a few dollars.[175] Traders recently reacted to an image depicting an apparent attack on the Pentagon, driving down stock prices. They soon learned that social media users had posted a fake image generated by artificial intelligence.[176] The damage was brief and was reversed at a system level, though it was discernible and consequential for participants. Similar events may have already occurred, without adequate attribution or understanding, by leaders in the United States, Europe, and elsewhere.[177]

While the U.S. government and others have focused on its potential in propaganda, states, organizations, factions, corporations, and individuals will also use it to engage in problematic – including hostile and illegal – activities.[178] They may engage in espionage against sovereign or corporate rivals, including by using synthetic avatars and other generated material to access facilities or systems or extract information that is beyond their reach today. They may also defraud, harass, or blackmail others. Authoritarians may use such technology to suppress and repress people under their rule.[179]

On another front, entities may be able to extract information directly from large language models, including information inputted during development, such as training a basic platform, and information inputted during use, such as enterprise customization or individual prompting.[180] They may also poison or otherwise manipulate data. Risks thus exist in the development of the technology itself, not just its foreseeable uses.[181]

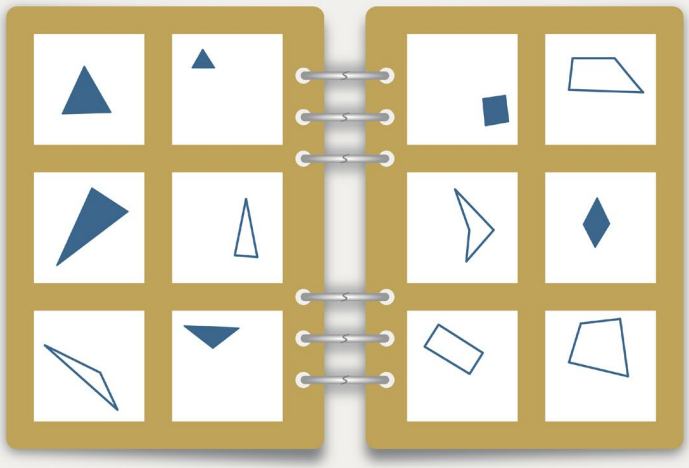
Makers of artificial intelligence claim they can prevent it from creating or contributing to risks, threats, and types of harm. At best, those claims have been incomplete even if they're correct; at worst, they've tried to minimize policymakers' perceptions of risk, promise unrealistic outcomes, and discuss control and responsibility inconsistently. Of course, any entity or person may use guardrails – such as technical restrictions, access limitations, and monitoring – to prevent outputs or uses that they consider problematic.[182] Setting aside other risks, like whether users or systems may fail to effectively reconcile different instructions, none of these limitations will be able to control the technologies and techniques they've created.

Others – including organized adversarial actors abroad, careless companies, or individuals at home – will eventually use the same technologies and techniques for their own purposes.[183] If an entity may use supervised learning or reinforcement learning – regardless of whether it is through human feedback, artificial feedback, or a combination of approaches – to achieve an objective or make certain outputs more or less likely, then another entity may use the same approach to achieve the opposite. Nor will they prevent misuse of their platforms, even if they establish restrictions or guardrails deemed generally sufficient or transcend inherent problems.[184]

States, state-owned enterprises, and associated actors have long been creating artificial intelligence programs, platforms, models, and systems. They may also be purchasing capabilities, services, and systems (from American and European providers). While they may do so to promote prosperity in their polities or protect themselves against adversaries, they have also engaged in nefarious activities, both at home and abroad. U.S.-based companies and Chinese state-owned or state-supported enterprises will continue to lead on "proprietary artificial intelligence." European entities will certainly be users of the technology and will craft rules for people living in their union and member states, but they may struggle with prospective rules that deter or make the development of proprietary platforms more costly. In other polities, including India, Japan, and Australia, developers will likely benefit from partnerships with public-sector entities, favorable economic orders, and sophisticated or well-endowed academic institutions. Indeed, the United Arab Emirates has already

Parallel Puzzles for Testing AI: How "Easy Things Are Hard"

Simple picture puzzles like this one are used by researchers to test AI's pattern recognition and meta-rationality. People, even young children, can generally recognize patterns rapidly and accurately. The Russian computer scientist Mikhail Moiseevich Bongard popularized these type of puzzles in a 1967 book. He explained that a group of scientists used these puzzles to research pattern recognition and perceptrons (algorithms typically used for binary classification). Researchers have since used these tests, or "Bongard problems," to develop and evaluate machine performance.



In this Bongard problem, the left side has triangles, while the right side has quadrilaterals.

Sources: New Lines Institute interviews, The New York Times, The Guardian, other books and journals

released a high-performing, large language model of its own – making it an early sovereign mover in the open-source space.[185]

Nor will artificial intelligence's consequences be confined to the digital domain or human societies. Building out the physical infrastructure contributes to adverse environmental change, including global climate change, regional degradation, and local warping.[186] Resource requirements for information infrastructure are already significant,[187] and they are not limited to standard estimates of energy consumption or carbon dioxide emissions, which don't necessarily account for changes due to built environments or eliminate externalization.[188] They may not yet discern the overall consequences, including ostensible net impact assessments of horizontal technology, its applications, its resource requirements, and its underlying or connected systems.[189]

Others will find familiar plateaus with this new technology. Humans may struggle with certain productivity paradoxes.[190,191] Nor will artificial intelligence necessarily liberate humans from poor conceptual understandings, ineffective data collection and classification techniques, or sloppy senses of relevant inputs, processes, and outputs. U.S. government units, for instance, will not be able to transform their work overnight. As they use artificial intelligence for scores of disclosed purposes,[192] they will also likely use it for national security, general operations, substantive analysis, counterespionage, fraud detection, and other sensitive applications both at home and abroad.[193] Without simply replicating "all the complexities of crafting strategic analysis," they may use artificial intelligence to "automate, enhance, and enable key parts of the analytic process" and "unlock new insights to inform analytic judgments."[194] However, they may neither reinvent their purposes nor transcend their limitations – whether they are due to the Constitution and laws or are embedded in the ethic of public service and responsibility to the American people.

Private-sector enterprises will also deal with paradoxes and plateaus. For instance, as law firms have embraced or become exposed to generative artificial intelligence, they've had to balance potential

efficiency in the short run against their way of work, sense of worth, or even existence in the long run.[195] As some leaders embrace the chance to save time, cut costs, and broaden their bases, others will fret over the future of firms that have in the past used "the daily grind to prepare leaders [to think carefully and manage work], even if a given task or process seems inefficient."[196] They must balance different client interests, too – for instance, the duty of care owed by human counsels and the cost savings of shifting some work to machines.[197] Others fret over poor lawyering, which they assess that artificial intelligence will exacerbate.[198]

These are not abstract concerns. After lawyers have made mistakes, U.S. judges are requiring them to disclose their use of artificial intelligence. For instance, one federal judge has required lawyers to certify that they have not used artificial intelligence platforms while drafting legal briefs or that a "human being" has checked "any language drafted by generative artificial intelligence" for accuracy while using print reporters or traditional legal databases.[199]

Ultimately, artificial intelligence will reflect and reinforce human agency, structures, virtues, and flaws. Humans design, develop, and deploy artificial intelligence systems, programs, and platforms. For instance, they express preferences through code and mathematics, create and classify datasets, and provide everything from underlying information to personal prompts. They also use technology and techniques as teams or individuals. They will enjoy benefits, suffer harm, be the subjects of, and otherwise live with, the consequences of their creations in society. So they must now learn to manage such technology and its consequences.

Human Society in an Age of Integrated Intelligence

Humans inevitably will embrace new technologies and techniques. They'll do so at different rates and at different degrees of depth and breadth. As some amplify advantages and accelerate advances with artificial intelligence, others will be unable to unlock potential and perhaps interact with platforms, models, and systems as the latest in a long line of curiosities. Given tiered societies and the complexity of consequences, American and other leaders must avoid trapping themselves in poor policies and practices. Moreover, without reacting counterproductively to events, they must strive for the sweet spots between the important and urgent, the innovative and the responsible, the private and the public, and so on.

These leaders must create and reshape structures and practices in the coming years. As they seek to increase the benefits, manage the burdens, and reduce the harm caused by artificial intelligence, humans must immediately adopt strategies, policies, and laws and in the longer run create standards, practices, and philosophical frameworks.[200]

In the United States, policymakers must create rules for artificial intelligence's design, development, and deployment;[201] handle complex inputs, opaque processes, and varying outputs; and account for everything from underlying intellectual property[202] and necessary data[203] to physical architectures and supply chains, and more.[204] Having long grappled with how to legislate or regulate new technologies, they must take the time to acquire "full understanding of all the implications and nuances," especially when "there is no social activity other than what is being done in the lab, [artificial intelligence] issues may not be ripe for legislative resolution or social trendsetting."[205]

Because they won't soon be able to resolve or transcend their "substantial uncertainty" regarding "how strongly" or "how rapidly" people will experience the effects of artificial intelligence,[206] "policymakers must be prepared for a range of potential outcomes."[207] They must "get curious"[208] and "get their hands around"[209] artificial intelligence. Without being intimidated, exceedingly deferential, or overawed, American leaders must not defer excessively to executives and engineers who may try to shift responsibility, cloud conversations, or preserve their positions by selectively shaping public rulemaking.[210] If nothing else, they have a chance to "at least avoid the mistakes of the past, speaking … about the Internet generally and social media companies specifically."[211]

Private industry participants exercise significant influence over this new technology. For

Service robots, driverless cars, and AI retail stores attract visitors at the exhibition area of the World Artificial Intelligence Conference in Shanghai, China in July 2021. (CFOTO / Future Publishing via Getty Images)

instance, they already oversee and fund a significant share of artificial intelligence research. Indeed, they've increased their influence over design and development – above all, on foundational research.[212] Not always aligning with American public policy or foreign policy, U.S.-based companies now dedicate far more resources than the federal government – excluding the U.S. Defense Department and associated actors – does in this area.[213]

Against this backdrop, American leaders at the federal, state, and local levels have been creating structures, crafting strategies, and issuing rules for artificial intelligence. Rather than rushing to regulate a technology, industry, or segment, American leaders have taken their time to consider effective approaches in this age of adoption. U.S. senators[214] have created frameworks to consider rulemaking in the long run; have established a process to consider legislation over months, rather than weeks or years;[215] and have already regulated – or have proposed ideas, entities, and processes to regulate – the consequences of technology in society, even absent specific, developed rules regarding the technology itself.[216] American lawmakers and officials must expand and refine these initiatives, ideally to consider rules without suppressing innovation, reflexively cutting down corporations, unduly raising costs for incumbent leaders and new entrants, or issuing overly broad or outlandish rules.[217]

While crafting new rules for the long run, American authorities may apply existing laws and regulations to artificial intelligence, its outputs, and its consequences.[218] In 2020, pursuant to a presidential executive order, the Office of Management and Budget issued guidance for how the U.S. government could apply regulations to artificial intelligence. Recognizing the need for "narrowly tailored and evidence-based regulations that address specific and identifiable risks," OMB nonetheless noted that "agencies must avoid a precautionary approach that holds AI systems to an impossibly high standard such that society cannot enjoy their benefits and that could undermine America's position as the global leader in AI innovation."[219] In the AI in Government Act of 2020, moreover, American leaders directed the General Services Administration to create an AI Center of Excellence and thus help the federal government adopt relevant technologies, techniques, and supporting infrastructure or practices. In the U.S. National Artificial Intelligence Initiative Act of 2020 and the U.S. National Defense

Authorization Act (2021 fiscal year), lawmakers addressed artificial intelligence applications specifically in the defense and security spheres.

Beyond all this, the U.S. government must improve its blueprints, expand its existing centers and committees, and direct its agencies to create or refine regulations. In principle, it has already done a great deal; in practice, it has yet to issue required plans, develop frameworks for declared strategies, report adequately on use cases, or incorporate artificial intelligence into its understanding of existing rules.[220]

In issuing its "Blueprint for an AI Bill of Rights," the White House anticipated that proposed policies and approaches would apply to specific automated systems that implicate the rights of people under the laws of the United States or create certain challenges, risks, and problems in practice.[221] Even without a uniform definition or set of similar standards, U.S. agencies must engage with artificial intelligence or automated systems through existing frameworks, such as those related to intellectual property rights and specific sectors.

Some agencies have already done so. For instance, the U.S. Patent and Trademark Office has recognized the intellectual property rights of persons who've used artificial intelligence in their underlying work, even though only individuals may be considered inventors.[222] Since 2019, moreover, the office has published reports and worked with others to "inform its future efforts on inventorship and promoting AI-enabled innovation."[223] It and other offices have also created and shared guidelines, essentially drawing distinctions between minimal and meaningful uses of artificial intelligence. In 2021, alone, the U.S. Food and Drug Administration considered "100 drug and biologic applications" that included artificial intelligence or machine learning in "a range of therapeutic areas" and "different developmental stages."[224]

Putting principles into practice, U.S. authorities – including the U.S. Consumer Financial Protection Bureau, the U.S. Federal Trade Commission, and the U.S. Justice Department's Civil Rights Division – have already engaged in and explained enforcement actions. Abroad, or in relation to foreign policy and national security, other agencies have applied existing rules to artificial intelligence while considering if special measures are appropriate. In time, they may also incorporate the technology and its uses into their understanding of restrictive measures: financial, sectoral,[225] or item-based,[226] entity-based, and catch-all.[227] Refining their practice in such areas, they may also create multidisciplinary teams to anticipate how actors may skirt the law or undermine its spirit with artificial intelligence, such as by unduly exercising market power or anticompetitive advantages with tools and resources such as time, attention, and data.[228]

State-level authorities in the United States must move more decisively, both to align with federal authorities and to avoid a problematic patchwork at the sub-federal level. Thus far, some states have been crafting creative and effective frameworks for artificial intelligence. To be sure, they've done so to encourage investment in this technology and associated areas, but they've also been regulating design, development, and deployment generally (say, in services) or specifically (such as government use). In Connecticut,[229] for instance, lawmakers have required government agencies to provide an annual inventory of artificial intelligence[230] systems and to assess any such system's impact before adopting or otherwise introducing it. This state has also prohibited relevant actors from using artificial intelligence in ways that unlawfully discriminate between or create unequal consequences for individuals.[231] Across America, city officials must also account for artificial intelligence more intensively. While they'll try to attract sector participants to boost their economies, they may unlock potential more generally by using the technology – and its necessary support infrastructure, which they may develop – to reimagine and improve public administration.[232]

Alongside legislators and officials, judges, arbiters, mediators, and others will grapple with generative artificial intelligence in different ways. Soon enough, they'll likely resolve foreseeable disputes related to artificial intelligence's inputs, including data[233] or intellectual property such as copyright;[234] programs and processes, including those covered by competing licenses, contracts, and terms of use; outputs, which will also involve competing human, enterprise, and other rights and duties; and consequences across the board.

The AI W Tower in Shanghai, China, is considered by some to be a landmark in the artificial intelligence industry. (CFOTO / Future Publishing via Getty Images)

The U.S. government and others may need to do more to shape this technology in the public interest. They need to increase investments in design and development rather than only regulating deployment. Even if American lawmakers and officials make virtues out of noninterference in the private sector,[235] they may sow the seeds of success beyond any election cycle or any incumbent's time in office.[236] For starters, they must increase investments in research – including basic, general, undirected research – with committed long-range funding. They may also create and promote partnerships, inspired by successful examples of federal, state, enterprise, and academic cooperation in California, Massachusetts, New York, Pennsylvania, and Virginia. They may also use procurement and partnerships to influence behavior, though U.S. federal agencies and associated actors "may be behind" in areas they once helped create and shape and may not "understand that their position in the [artificial intelligence] space is not as important as it once was to companies [that now need] to accommodate customers around the world."[237]

Others around the world must do the same, bearing in mind that artificial intelligence is a specific area, part of broader sectors, and another ubiquitous technology in a complex contemporary age. Of course, leaders will differ in their approaches, including across global, common, civil, and other laws.[238] Although states may address issues through existing institutions and mechanisms, they may consider creating dedicated coordinating commissions and working groups – with constituent bodies on technical issues, policy, and principles – to effectively embrace artificial intelligence on the international plane.[239] Several such international bodies – including those on telecommunications, aviation, and outer space – could serve as effective models.[240]

From there on, officials, diplomats, and technical or policy advisers could harmonize at least some rules – including what amount to dedicate to basic industry risk management practices.[241] In addition, global leaders and diplomats will need to account

for artificial intelligence in their mainline institutions and processes. For instance, the 2008 System of National Accounts neither defines nor accounts for artificial intelligence in economies around the world. Having generally designated "digitalization" as a priority area for the forthcoming 2025 System of National Accounts, the relevant international working group will recommend specific measures related to artificial intelligence.[242]

Continental, regional, and other unions and associations will also play their part. They've already started to grapple with artificial intelligence, both generally and specifically. Above and alongside its member states, for instance, the European Union has passed a general law on artificial intelligence, applied rules pertaining to privacy, and begun developing a risk-based framework for the technology's uses and effects in different segments.[243] While European rule makers haven't necessarily trapped themselves in bad rule sets, they've moved early and prioritized certain rights.[244] Thus far, they've focused on protecting privacy, avoiding risk, and limiting potential monopolists or influential market participants, being especially those concerned with U.S.-based global information technology companies.[245] Along with banning certain applications – such as predictive policing, real-time biometrics, and emotion-recognition systems – Europeans have otherwise restricted or imposed parameters on other uses, depending on envisioned risk categories.[246]

While they may achieve some of their objectives, European leaders may also stifle some innovation, increase costs, and find it difficult to protect technological sovereignty in sensitive areas.[247] Moreover, they may struggle to develop full frameworks through which officials and regulators may improve upon and ultimately enforce the law.[248]

Institutions, enterprises, and individuals around the world will need to adopt standards and better practices as they become more familiar with artificial intelligence. Above all, they must work to avoid sliding into long-term rules by formalizing and otherwise perpetuating short-term reactions as long-term rules.[249] In the U.S. government, for instance, teams may blend technical and nontechnical skills and perspectives; and they may experiment, "via pilot projects and organizational sandboxes"; and they may otherwise apply existing laws and codes of conduct to norms and best practices – including, incidentally, at unit and individual levels.[250] (For instance, the U.S. Defense Department has created Task Force Lima on generative artificial intelligence as part of its Chief Digital and Artificial Intelligence Office.[251]) Enterprises and individuals will also need to do so while using artificial intelligence in their substantive work.[252]

Stakeholders have been cautious thus far. For instance, although they already use rudimentary artificial intelligence to screen candidates, monitor employees, and predict or even shape customer behavior, companies have banned employees, contractors, and partners from using certain models, systems, or platforms over the past year. Global corporations,[253] regional enterprises, and small startups have done so due to concerns about the quality of work,[254] the treatment of sensitive information,[255] and general prudence regarding the unfamiliar, assessing that it is preferable to prohibit rather than permit the incomprehensible or complex until "properly considered."[256] Others have simply planned poorly, have confined artificial intelligence to specialized shops, or have folded it into their basic operations, information technology, or digital security. Besides failing to unlock the technology's potential, they've also not effectively educated their employees, contractors, and partners on the narrower effects they've deemed relevant. They must all do better, regardless of their baselines, or they'll find themselves vulnerable.[257]

Despite "clear concerns and fears,"[258] administrators, teachers, and students may include artificial intelligence in classroom exercises, homework, and exams; may reconsider relevant skills, including competency or literacy in artificial intelligence;[259] and may change their approaches to learning generally.[260] Learning from the past so they may teach in the future, lawmakers, executive departments, school boards, and parents must stop reflexively banning technology and techniques in this area. After all, they've long since turned other tools for learning from classroom contraband into requirements in school, in the workplace, and for life – such as calculators, computers, open-book exams,

A General Guide to Policy and Practice in New Human Areas of Activity

Innovators and executives are involved in shaping technology through all its phases. They design, develop, and deploy technology. Although lawmakers, officials, analysts, and activists may be interested in design and development, they are often unable or unwilling to shape technology or its related policies and practices until it has already been deployed. The New Lines Institute has prepared briefing materials on how lawmakers, officials, and administrators may involve themselves in earlier phases of the technology pipeline.

	Design →	Develop →	Deploy
Innovator/executive	✓	✓	✓
Lawmaker/official	?	?	✓
Analyst/activist	?	?	✓

Sources: New Lines Institute research including interviews with former U.S. government officials, officers, engineers, scholars, and other books, journals, and technical papers from 2022 and 2023.

take-home tests, audiovisual materials, virtual forums, and more. And while access and ease matter, educators must not conflate technical possibility with risk more generally – especially given how students may already cheat or game the system.[261] They may also need to grapple with how artificial intelligence affects human senses of knowledge, learning, and self.[262] Indeed, they may enrich education by embracing new technology and techniques.[263]

Despite increasing life spans and improving quality of life for generations of humans, health care providers will increasingly turn to a revolutionized resource in the age of integrated intelligence: data.[264] As developers assess that data will become more important for artificial intelligence systems generally, health care providers will need to balance the benefits of artificial intelligence with the burdens of creating and improving any platform or model. Privacy will be a problem, with the potentially negative consequences in this area – including, say, insurance denial – being especially dire. Providers could work with federated data and autonomous or protected systems. In principle, they may be able to create and improve localized artificial intelligence systems and thus use the power of large models without feeding information to some connected or mother system; but practice is the problem, as always.[265]

Engaging designers, developers, and deployers of artificial intelligence, lawmakers, officials, businesspersons, and others will need to refine rules made for humans. Implicating and complicating intellectual property, privacy,[266] and data rights and rules,[267] artificial intelligence is also "deeply intertwined" with human "health, education, freedom of movement, freedom of peaceful assembly, freedom of association and freedom of expression."[268] Ultimately, artificial intelligence may reshape the human sense of self – regardless of whether and how a particular system or process is intrinsically different from machines and mechanisms of the past or whether humans think, react, and feel differently about the processes and outputs of such systems.[269] Lawmakers, officials, and judges will do their part, exercising forms of human agency that are as inevitable as they are flawed. As some try to create predictable but

flexible rules for whether and how to recognize the rights of people[270] who create, use, and are otherwise affected by artificial intelligence, people will in turn find clarity – though perhaps not comfort – by contract, in the market, and through personal practice.[271]

Having not yet accounted for immediate and important consequences of artificial intelligence, American, European, and other leaders have fretted over systemic and longer-range consequences, such as stresses on prevailing modes of government, commerce, and political economy,[272] and over deeper sentiments, including by those who now see humans as a precursor for synthetic superintelligence.[273] Of course, they must account for low-chance, high-consequence phenomena.[274] Without unduly fixating on the distant future, though, they must also proactively address intended and unintended consequences, foreseeable and unforeseeable developments, and threats and risks. And they must first focus on "immediate"[275] challenges while bearing in mind that they must not regulate artificial intelligence quickly at the expense of regulating it effectively and enduringly.[276]

Neither seduced by promise or fixated on their fears, they must embrace the inevitable cautiously – that is, by understanding that they have agency, retain the ability to learn, and are more than merely "in the loop" when it comes to their societies' futures. Without trying to pursue perfection in artificial intelligence, especially given that humans have been imperfect in practice long before the contemporary computing age, they may nonetheless work to maximize benefits, minimize harm, and otherwise account for complex consequences at this future frontier. ☐

Note: *Anthony is available to discuss the special report at aelghossain@newlinesinstitute.org. He wishes to thank the Institute team and all interlocutors for making this work possible with their time, energy, and insight.*

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Endnotes

1 Turing, A. (1950, October). *Computing Machinery and Intelligence.* Mind. https://www.jstor.org/stable/2251299

2 Homer. *The Iliad*. Hephaestus, for instance, made wheeled servants and golden women to help him in his mythical workshop.

3 Truitt, E.R. (2016). *Medieval Robots: Mechanism, Magic, Nature, and Art.* University of Pennsylvania Press.

4 "They adorned majestic pseudo-trees with metal birds; posted mechanical warriors as symbolic protectors, or perhaps as unsubtle entertainment, in the halls leading to their throne rooms or chambers; and set in their palaces simulated scenes from nature." Mayor, A. (2018). *Gods and Robots: Myths, Machines, and Ancient Dreams of Technology.* Princeton University Press. Truitt, E.R. (2016). *Medieval Robots: Mechanism, Magic, Nature, and Art.* University of Pennsylvania Press.

5 Clark, W., Golinski, J., & Schaffer, S. (1999). *The Sciences in Enlightened Europe.* University of Chicago Press. https://press.uchicago.edu/ucp/books/book/chicago/S/bo3623650.html

6 As ever, technology was a tracer for strategic, economic, and sociocultural dynamics and change. Having intermittently isolated from and engaged others, Chinese, Japanese, and other elites began importing European and then American goods and technology.

7 Stein, D. (1985). *Ada: A Life and a Legacy.* MIT Press. https://monoskop.org/images/e/e7/Stein_Dorothy_Ada_A_Life_and_a_Legacy.pdf

8 The British made "Colossus" for codebreaking, while the Americans made "ENIAC" for ballistic firing tables. Interviews and conversations with former senior U.S. government officials, engineers, and computer scientists, November 2022–July 2023.

9 Interviews and conversations with historians, social scientists, artificial intelligence developers, and ethicists, November 2022–July 2023. Turing, A. (1950, October). *Computing Machinery and Intelligence*. Mind. Turing proposed an exercise in which one human and one machine would engage in a natural language conversation while another human with no knowledge of or access to the conversing human and machine would observe the exchange. If the human observer could not discern a difference between the human and machine, then the machine would essentially pass the test. In the decades since, scholars, engineers, and others have debated whether machines have passed the so-called Turing test — with some going so far as to turn the test into a sort of threshold for sentience. While scholars agree that the test is important, they differ regarding its significance and have increasingly debated whether the test says more about the machine, the conversing human, or the observing human.

10 Interviews and conversations with computer programmers and artificial intelligence developers, November 2022–July 2023. After all, machines now seemed to have some of the basics that humans deemed necessary for intelligence. Machines completed tasks; they were thus doing the equivalent of "thinking" or "acting." Machines could store information, increasingly including previous commands or outputs; they were thus doing the equivalent of "remembering" or at least having a "memory."

11 Interview with enterprise leads and computer scientists, including a developer of artificial intelligence at a large U.S.-based global corporation and deployers of artificial intelligence in U.S. government and companies, November 2022–July 2023.

12 Interviews and conversations with artificial intelligence developers and enterprise managers, March 2023–June 2023.

13 Interviews with engineers and computer scientists, November 2022–December 2022.

14 McCarthy, J., Minsky, M.L., Rochester, N., & Shannon, C.E. (1955, August). *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence*. The scholars developed and proposed the project in 1955 and completed it during the summer of 1956.

15 Clark, W., Golinski, J., & Schaffer, S. (1999). *The Sciences in Enlightened Europe.* University of Chicago Press. https://press.uchicago.edu/ucp/books/book/chicago/S/bo3623650.html

16 Wiener, N. (1948). *Cybernetics: Or Control and Communication in the Animal and the Machine.* Second edition, https://direct.mit.edu/books/book/4581/Cybernetics-or-Control-and-Communication-in-the

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18 Turing, A. (1950, October). *Computing Machinery and Intelligence*. Mind. https://www.jstor.org/stable/2251299

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20 Conversations with executives and artificial intelligence developers, including at two conferences, during sidebar meetings, and individual interviews, March 2023–May 2023.

21 Hiller, L. & Isaacson, L. (1959). *Experimental Music: Composition with an Electronic Computer.* McGraw-Hill. See Chapter 6 for notes on the Iliac Suite.

22 Ariza, C. (2011). *Two Pioneering Projects from the Early History of Computer-Aided Algorithmic Composition.* Computer Music Journal 35.3. Massachusetts Institute of Technology.

23 Moravec, H. (1988). *Mind Children: The Future of Robot and Human Intelligence.* Harvard University Press. Dreyfus, H.L. (1965). *Alchemy and Artificial Intelligence.* RAND Corporation. https://www.rand.org/pubs/papers/P3244.html

24 Dreyfus, H.L. (1965). *Alchemy and Artificial Intelligence.* RAND Corporation. https://www.rand.org/pubs/papers/P3244.html

25 Dreyfus, H.L. (1965). *Alchemy and Artificial Intelligence*. RAND Corporation. https://www.rand.org/pubs/papers/P3244.html. *Mind Children: The Future of Robot and Human Intelligence*. Harvard University Press. Dreyfus, H.L. (1965). Mitchell, M. (2020, November 17). *Artificial Intelligence: A Guide for Thinking Humans.* Picador.

26 Dreyfus, H.L. (1965). *Alchemy and Artificial Intelligence.* RAND Corporation. https://www.rand.org/pubs/papers/P3244.html. Moravec, H. (1988). *Mind Children: The Future of Robot and Human Intelligence.* Harvard University Press. Mitchell, M. (2020, November 17). *Artificial Intelligence: A Guide for Thinking Humans*. Picador.

27 Dreyfus, H.L. (1965). *Alchemy and Artificial Intelligence.* RAND Corporation. https://www.rand.org/pubs/papers/P3244.html. Moravec, H. (1988). *Mind Children: The Future of Robot and Human Intelligence*. Harvard University Press. Mitchell, M. (2020, November 17). *Artificial Intelligence: A Guide for Thinking Humans.* Picador.

28 Conversation with historian, April 2023. The historian agreed that such boosterism was another form of self-capturing behavior in an industry or a community of specialist researchers and practitioners.

29 Interviews and conversations with historians and social scientists, including about the secondary sources New Lines has relied upon in this report, January 2023–June 2023. In a seminal, prescient book on cybernetics, for instance, the scholar Norbert Wiener in the 1940s warned against "hucksters" and technology or gadget "worshipers."

30 National Research Council. 1999. *Funding a Revolution: Government Support for Computing Research*. Washington, D.C.: National Academies Press. See Chapter 9 (Development in Artificial Intelligence).

31 Conversations with computer programmer, cybersecurity specialist, and military officers, December 2022–June 2023. Mitchell, M. (2020, November 17). *Artificial Intelligence: A Guide for Thinking Humans.* Picador.

32 Shapiro, E. (1983, September). *The Fifth Generation Project: A Trip Report.* Communications of the ACM. American. Conversation with think tank director and analyst, May 2023, as well as conversations with artificial intelligence developers and executives at a conference, May 2023.

33 Interviews and conversations with historians, computer scientists, and artificial intelligence developers at U.S.-based global information technology corporations, November 2022-July 2023. Ryan, M. (2021, July 1). *An Evolving Twentieth-Century Profession: Technology After World War II*. Modern War Institute at West Point.

34 Besides using terms like "machine learning" to speak specifically about subdisciplines, scientists and scholars also did so to avoid sounding strange or wacky in academic, government, and enterprise settings. One artificial intelligence developer at a U.S.-based global corporation helped pioneer its existing systems in the mid-2010s and yet spent years "talking about [his work] with other labels." Conversations with executives and developers, including at two conferences, during sidebar meetings, and individual interviews, March 2023-May 2023.

35 Metz, C. (2016, March 24). *One Genius' Lonely Crusade to Teach a Computer Common Sense*. Wired. https://www.wired.com/2016/03/doug-lenat-artificial-intelligence-common-sense-engine/

36 Hedberg, S. (2002, May). *DART: Revolutionizing Logistics Planning*. IEEE Intelligent Systems.

37 Interview with academic, June 2023. Lang, N. (2022, December 9). *The Power of GPUs: Revolutionizing Computing and Unlocking New Frontiers*. Towards Data Science. https://towardsdatascience.com/why-does-a-graphics-card-help-in-machine-learning-8f365593b22.

38 While all artificial intelligence models essentially include some forms of recognition, processing, and generation, they differ in primary purposes and designs of platforms, models, and systems. Some artificial intelligence programs recognize information: for instance, the image of a bird, the image of a traffic light, the image of a cookie, or the image of a cat. Others may generate such images or other information like text or sound.

39 Although scientists and scholars have worked with backpropagation since the 1960s, some of them used it and other techniques to take a leap forward in the development of artificial intelligence in the 1980s. While scholars assess that backpropagation is simple to define and to understand conceptually, they also emphasize that it is an approach prone to "leaky abstraction."

40 Rumelhart, D., Hinton, G., & Williams, R. (1986). *Learning representations by back-propagating errors*. Nature. https://www.nature.com/articles/323533a0

41 Interview with artificial intelligence developer, May 2023.

42 Interviews with computer scientists, academics, and artificial intelligence developers, November 2022-July 2023.

43 Wired ran "The New Face of AI" on the cover of its March 2022 issue.

44 Fulfilling an old promise, the computer's creators yet again demonstrated the difference in time frames between individual lives and innovation arcs. Big Blue, the IBM computer, beat Gary Kasparov, the world chess champion, in 1997; early boosters of artificial intelligence had predicted a computer would play champion-level chess by 1967. Those 30 years were half a lifetime for the average person of the age and yet represent an infinitesimal span in human history or even in the development and adoption of technology.

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55 Interviews and conversations with academic, March 2023-June 2023.

56 In the mid-2010s, an artificial intelligence program defeated Deep Blue in chess, while a Google program defeated the world champion in Go.

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65 Interviews with historians, social scientists, lawyers, computer scientists, developers, engineers, and corporate executives, November 2022–July 2023.

66 Interviews with historians, social scientists, lawyers, computer scientists, developers, engineers, and corporate executives, November 2022–July 2023. Referring to comments by corporate executives and others during a panel event and conference, an artificial intelligence developer for a global U.S.-based information technology company emphasized the term "adoption."

67 Interviews with artificial intelligence developers and artificial intelligence governance analyst, March 2023–May 2023; conversation with historian of technology, May 2023. Conversations with end users – including accountants, bankers, doctors, engineers, lawyers, officials, political analysts, and teaching academics – November 2022–July 2023.

68 Generative artificial intelligence may create complex data; other artificial intelligence, such as discriminatory artificial intelligence, may produce outputs based on inputs and a narrower set of options.

69 Interviews and conversations with historians, social scientists, and computer scientists, November 2022–July 2023. Milmo, D. *ChatGPT reaches 100 million users two months after launch*. Guardian. Global population growth and increasing internet access. https://www.theguardian.com/technology/2023/feb/02/chatgpt-100-million-users-open-ai-fastest-growing-app

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73 Interviews with historians, social scientists, lawyers, computer scientists, developers, engineers, and corporate executives, November 2022–July 2023.

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75 Interviews and conversations with artificial intelligence developers, March 2023–May 2023.

76 Microsoft has integrated ChatGPT or similar models into its software suites, search engine, and enterprise systems while adding or highlighting artificial intelligence in other products; OpenAI has released or boosted other platforms such as the image-generating DALL-E while actively supporting enterprises seeking to patch ChatGPT or other products into its services and systems (making its products apps in some domains and "meta-apps" in other domains). Interviews and conversations with executives, artificial intelligence developers, and technology journalists, March 2023–June 2023. Johnson, K. & Knight, W. (2023, June). *ChatGPT, Unleashed*. Wired.

77 Interviews and conversations with executives, artificial intelligence developers, and technology journalists, March 2023–June 2023.

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85 Conversation with former senior U.S. government official, May 2023.

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92 Interviews and conversations with venture leads, including at large financial institutions, health care provider networks, and startups in the United States, March 2023-July 2023. New Lines Institute is quoting an engineer who has designed, developed, and deployed such technology in global companies areas of energy, infrastructure, and related services and logistics; as part of the operations of world-scale infrastructure projects; and on behalf of financial institutions.

93 Interview with venture lead who has designed, developed, and used artificial intelligence at global energy, infrastructure, and financial firms for at least a decade, July 2023.

94 Interviews and conversations with government officials, corporate executives, interdisciplinary research team leads, and artificial intelligence developers, March 2023-May 2023.

95 Interviews and conversations with specialist data lawyer, January 2023-June 2023. U.S. agencies may decline to report certain technologies and techniques, including artificial intelligence at different stages of development. Interlocutors may also be unaware of, or unable or unwilling to divulge details related to, existing or forthcoming uses of artificial intelligence by governments.

96 Chui, M., Eric Hazan, H., Roberts, R., Singla, A., Smaje, K., Sukharevsky, A., Yee, L., & Zemmel, R. (2023, June 14). *The economic potential of generative AI: The next productivity frontier.* McKinsey & Company. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier

97 Although scholars and analysts have been able to assess potential exposure to artificial intelligence across the economy and in different sectors, they have thus far studied specific uses, teams, and companies while considering any differences in productivity. Brynjolfsson, E., Li, D., & Raymond, L. (2023 April). *Generative AI at Work*. National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w31161/w31161.pdf. Bailey, M., Brynjolfsson, E., & Korinek, A. (2023, May 10). *Machines of mind: The case for an AI-powered productivity boom.* Brookings Institution. https://www.brookings.edu/research/machines-of-mind-the-case-for-an-ai-powered-productivity-boom/

98 Interviews with artificial intelligence governance analyst and artificial intelligence developer for financial institution, May 2023.

99 Conversations with technology transfer lawyers, March 2023.

100 Interview with engineers and economists, including those who've worked for global design consultancies, global hydrocarbons extraction companies, oil services companies, renewable energy operations, and maintenance projects, November 2022-July 2023.

101 Conversations with engineer and venture team lead, March 2023-June 2023.

102 Interviews with academic and with geopolitical analyst, March 2023-June 2023.

103 Interviews with developers of customized artificial intelligence stacks, deployers of artificial intelligence at large law firms and bio-innovation firms, and with academics and analysts, January 2023-June 2023.

104 Interviews and conversations with U.S. government officials, lawyers, academics, and analysts, January 2023-June 2023.

105 "Chat" with an "Assistant," a publicly available artificial intelligence program that provided outputs describing itself as a "general-purpose language model" trained "to perform a wide range of natural language understanding and generation tasks." Although different scholars and lawyers have debated whether and how to recognize artificial intelligence programs and/or their outputs, the author has generally considered available and accessible chat-based platforms to be tools rather than sources or authors. As part of ongoing, long-range research, the author has used artificial intelligence platforms alone and alongside others including computer scientists, developers, and enterprise users since late 2022. In its outputs, the "Assistant" indicated that it could generate outputs, when provided with inputs such as prompts, "on a wide range of topics, from general knowledge to specific areas of expertise like science and history. It may generate text "in a variety of formats, including articles, stories, and essays." It may translate, at least in text. It may summarize works by "extracting key information and condensing it into a shorter form." It may explain concepts, in a way that is "easy to understand." And it may do more, "depending on the complexity of the task and the information available."

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107 Interviews and conversations with historians, social scientists, and artificial intelligence developers, November 2022–July 2023. New Lines Institute is specifically quoting an academic who granted an interview in June 2023.

108 Presentation at conference, May 2023. In conversations after the presentation, executives and developers discussed differences between applying artificial intelligence to online advertising and applying it to online defect detection.

109 Conversations at artificial intelligence conference, following up on technical presentation on artificial intelligence in different business — including in the so-called long tail of adoption, May 2023.

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113 Schork, N. (2019, June). *Artificial Intelligence and Personalized Medicine*. Cancer Treatment and Research Book Series. Approved version available to the public: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7580505/. Conversation with executive at U.S.-based global computer technology company working with health care providers across the United States, May 2023. To account for "individual variability" and make precision medicine possible, for instance, doctors and researchers need information from "large-scale biologic databases (such as the human genome sequence)" to "powerful methods for characterizing patients (such as proteomics, metabolomics, genomics, diverse cellular assays, and even mobile health technology)." They also need "computational tools" to actually analyze the data. Collins F. & Varmus H. (2015, February 26). *A New Initiative on Precision Medicine*. New England Journal of Medicine. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5101938/

114 One Hundred Year Study on Artificial Intelligence. (2016, September). *Artificial Intelligence and Life in 2030*. https://ai100.stanford.edu/sites/g/files/sbiybj18871/files/media/file/ai100report10032016fnl_singles.pdf

115 Interviews and conversations with executives at U.S.-based global technology companies, medical doctors, and business development teams at biotechnology startups, November 2022–July 2023.

116 Interviews and conversations with venture investor and manager at bio-innovation firm, startup founder, and executive at U.S.-based global computer technology company working with health care providers across the United States, May 2023.

117 Interviews and conversations with executive at U.S.-based computer technology company, biotechnology company executives, and artificial intelligence developers at financial institutions and smaller enterprises, March 2023–June 2023.

118 Heikkiläarchive, M. & Heaven, W. (2022, December 23). *What's next for AI*. MIT Technology Review. https://www.technologyreview.com/2022/12/23/1065852/whats-next-for-ai/. Other parts of the production pipeline, such as clinical trials and regulatory classification, approval, or nonobjection, will still take years, regardless of whether people, programs, or both developed relevant drugs.

119 Interview with artificial intelligence developer at bio-innovation firm, May 2023. In conversations, executives and managers at large data management companies and pharmaceutical startups shared the same vision or ambition.

120 Interview with venture lead who has designed, developed, and used artificial intelligence at global energy, infrastructure, and financial firms for at least a decade, July 2023.

121 Kaku, M. (2023). *Quantum Supremacy: How the Quantum Computer Revolution Will Change Everything.* Doubleday.

122 Interview with venture lead who has designed, developed, and used artificial intelligence at global energy, infrastructure, and financial firms for at least a decade, July 2023; conversations with energy and infrastructure lawyers, economists at hydrocarbons companies, and managers at energy services corporations, January 2023–June 2023.

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127 U.N. Environment Programme and Food and Agriculture Organization of the United Nations (2022). *Sustainable Food Cold Chains: Opportunities, Challenges, and the Way Forward*. https://coolcoalition.org/sustainable-food-cold-chains-report/

128 Interview with venture lead who has designed, developed, and used artificial intelligence at global energy, infrastructure, and financial firms for at least a decade, July 2023.

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150 Conversations with artificial intelligence ethicist and with designer and deployer of artificial intelligence systems, who has created at university labs, global corporations, smaller startups, and venture-supported entities over the past 15 years, May 2023.

151 Interviews and conversations with executives at large data and biotechnology companies, artificial intelligence developers in governments, at large financial institutions, and smaller enterprises and startups, March 2023-June 2023.

152 Interviews and conversations; New Lines Institute experiential research, including prompting and observation of prompting of artificial intelligence platforms, November 2022-July 2023.

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190 "You can see the computer age everywhere but in the productivity statistics." – Robert Solow, 1987.

191 If people do not become more productive quickly, it may be because they have not yet adopted technology or because they are still learning to orient their work around it. Artificial intelligence may not be any different. Through practices and policies, or even embedded expectations of leaders, individuals and teams may eventually replace existing forms of mundanity with emerging forms of mundanity. Interviews with historians, social scientists, lawyers, computer scientists, developers, engineers, and corporate executives, November 2022–July 2023.

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197 Interviews and conversations with lawyers working in private practice or as general counsel, November 2022–July 2023.

198 Conversation with technology practice partner at global law firm, April 2023.

199 In the U.S. District Court for the Northern District of Texas, Judge Brantley Starr issued in early 2023 a judge-specific requirement on artificial intelligence: https://www.txnd.uscourts.gov/judge/judge-brantley-starr. "These platforms," the judge wrote, "are incredibly powerful and have many uses in the law: form divorces, discovery requests, suggested errors in documents, anticipated questions at oral argument. But legal briefing is not one of them. Here's why. These platforms in their current states are prone to hallucinations and bias. On hallucinations, they make stuff up — even quotes and citations. Another issue is reliability or bias. While attorneys swear an oath to set aside their personal prejudices, biases, and beliefs to faithfully uphold the law and represent their clients, generative artificial intelligence is the product of programming devised by humans who did not have to swear such an oath. As such, these systems hold no allegiance to any client, the rule of law, or the laws and Constitution of the United States (or, as addressed above, the truth). Unbound by any sense of duty, honor, or justice, such programs act according to computer code rather than conviction, based on programming rather than principle."

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211 Interview with former senior official in the U.S. government, May 2023.

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215 Center for Strategic and International Studies. (2023, June 21). "Sen. Chuck Schumer Launches SAFE Innovation in the AI Age at CSIS." Event Transcripts. https://www.csis.org/events/sen-chuck-schumer-launches-safe-innovation-ai-age-csis

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254 Conversation with designer and deployer of artificial intelligence systems who has created at university labs, global corporations, smaller startups, and venture-supported entities over the past 15 years, May 2023; conversations with venture leads, including at large financial institutions, health care provider networks, and startups in the United States, March 2023–July 2023.

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272 Interviews and conversations with artificial intelligence, bankers, lawyers, and ethicists, March 2023–June 2023.

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275 Interviews with government-supported artificial intelligence developer, March 2023–June 2023.

276 Interviews and conversations with U.S. legislative staff, U.S. government lawyers, lawyers in private practice, and artificial intelligence governance analysts, March 2023–June 2023.

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